

AN EMENDATION AND PRELIMINARY SURVEY OF THE GENUS  
CALVATIA (GASTEROMYCETIDAE)

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The gasteromycetous genus *Calvatia* is enlarged to include *Langermannia*, *Lanopila* (*Lasiosphaera*), *Hypoblema*, and *Gastropila*, but *Calbovista*, and *Handkea* remain separate. 35 species of *Calvatia* are enumerated and arranged in eight sections. On species rank, six new combinations and one nomen novum are proposed.

The gasteromycetous genus *Calvatia* Fr. 1849 (Lycoperdaceae) has never been monographed as a whole, but regional revisions have been published e.g. for Brazil (Silveira, 1943), Australia and New Zealand (Cunningham, 1944), South Africa (Bottomeley, 1949), Central Europe (Smarda, 1958; Kreisel, 1962), North America (Zeller & Smith, 1964), Kazakhstan (Shvartsman & Filimonova, 1970), Armenia (Melik-Khatchatryan & Martirosjan, 1971), China (Liu, 1984), and the arctic regions (Miller & al., 1980; Lange, 1990). Segregated genera have been dealt with e.g. by Morse (1935: *Calbovista*), Homrich & Wright (1973: *Gastropila*, *Lanopila*), Ponce de León (1976: *Gastropila*), Kreisel (1989: *Handkea*), and Calonge & Martín (1990: *Gastropila*, *Langermannia*).

As proposed by Kreisel (1989), the genus *Calvatia* Fr. should be restricted to species with capillitium hyphae of *Lycoperdon* type, articulated in more or less regular distances by true septa (Fig. 1) and provided—if pits are present—with circular to elliptic, never slit-like pits. By this definition, *Calvatia* does not include *Calbovista* Morse 1935 (Capillitium *Bovista* type, with false septa, no pits; one species), *Calvatiella* Chow 1936 (Capillitium *Bovista* type, pitted; two badly known species), and *Handkea* Kreisel 1989 (Capillitium *Lycoperdon* type, with no or false septa, pits elongated, slit-like; eight species).

The following synonyms belong to *Calvatia* as conceived here.—

*Langermannia* Rostk. 1839, nomen rejiciendum. Type species: *Lycoperdon giganteum* Batsch 1786 : Pers. 1801.

*Hippoperdon* Mont. 1842, nomen rejiciendum. Type species: *H. crucibulum* Mont. 1842.

*Lanopila* Fr. 1848. Type species: *L. wahlbergii* Fr. 1848.

*Lasiophphaera* Reichardt 1870. Type species: *L. fenzlii* Reichardt 1870.

*Eriosphaera* Reichardt ex de Toni 1880, non Lessone 1832. Type species: *Lasiosphaera fenzlii* Reichardt 1870.

*Hypoblema* C.G. Lloyd 1903. Type species: *Lycoperdon lepidophorum* Ell. & Ev. 1885.

*Pila* Speg. 1921, non Bertrand & Renault 1892. Type species: *Mycenastrum fragile* Lév. 1844.

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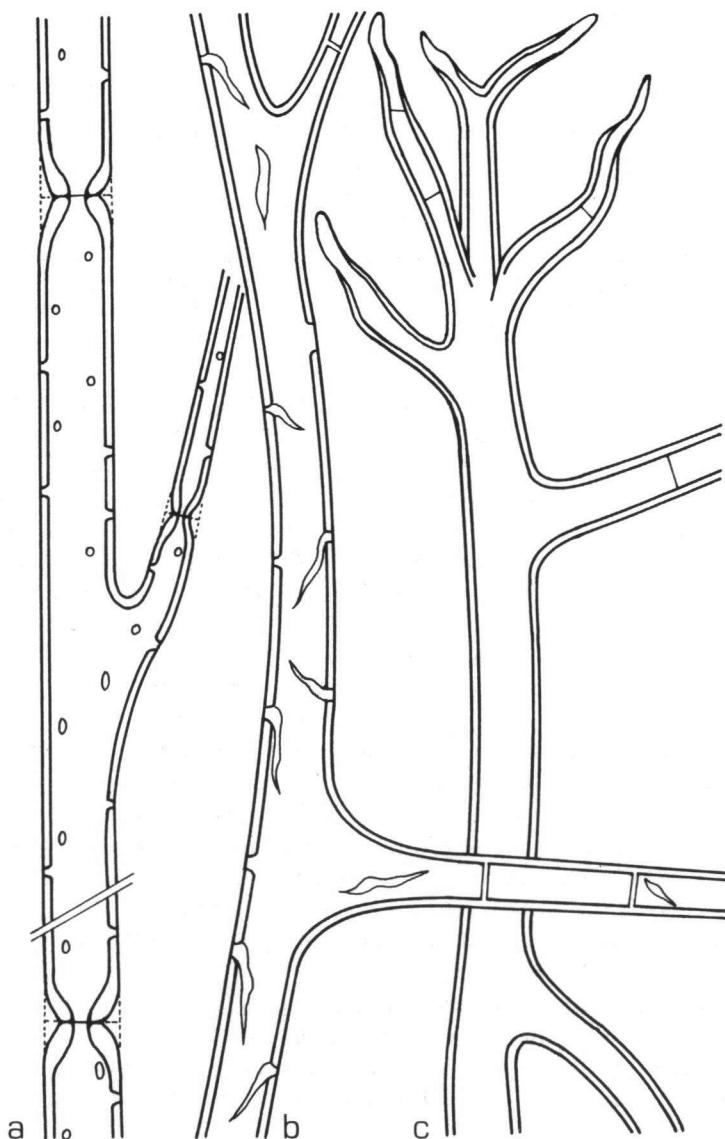


Fig. 1. Pattern of capillitium characters in a. *Calvatia*, b. *Handkea*, and c. *Calbovista*.

*Gastropila* Homrich & Wright 1973, nom. nov. Type species: *Mycenastrum fragile* Lév. 1844.

There is a nomenclatural inconvenience. The name *Calvatia* is a nomen conservandum (Greuter & al., 1988 (= ICBN): 132) and as such protected against the older synonyms *Langermannia* Rostk. and *Hippoperdon* Mont., but not against the older name *Lanopila* Fr. 1848 (ICBN: Art. 14.4). Herewith it is proposed to reject the name *Lanopila* Fr. 1848 in favour of the taxonomic synonym *Calvatia* Fr. 1849, for the latter has been recombined and used currently with many more epithets belonging to the genus in question.

Most species of *Calvatia* live in dry or mesophilic grassland, in arctic-alpine meadows, or in semi-desertic vegetation, some in gardens and cultivated soils. Only a few species occur in forests and other shady places: *Calvatia craniiformis*, *C. pyriformis*, *C. subtomentosa*, *C. longicauda*, *C. sculpta* and, sometimes, *C. gigantea* and *C. crucibulum*.

The genus *Calvatia* has a world-wide distribution, extending from the continental arctic deserts at 82°42' latitude in Peary Land (Greenland), as recorded by Lange (1990), and from the antarctic zone in Fireland, to the moist and the arid tropics. But all individual species have limited, characteristic areas.

An attempt of Zeller & Smith (1964) to arrange 32 recognized North American species (incl. *Handkea*) in seven stirpes was not satisfying, for some of these groups appear rather heterogeneous and unnatural. The author proposes to arrange 35 recognized taxa in eight sections as follows.—

### 1. *Calvatia* sect. *Calvatia*

*Calvatia* sect. *Langermanniopsis* Kreisel 1962.

*Calvatia* stirps *Craniiformis* Zeller & Smith 1964.

Type species: *Lycoperdon craniiforme* Schw. 1832.

Subgleba cellular, or compact, or none. Exoperidium furfuraceous. Capillitium pitted or not. Mature gleba olivaceous brown.

a) Capillitium with large pits

*Calvatia craniiformis* (Schw. 1831) Fr. 1849

Eastern and Cent. U.S.A., Japan, China, ? Transcaucasia; forests. Type from N. Carolina, U.S.A.

*Calvatia pyriformis* (Lév. 1846) Kreisel, *comb. nov.*

*Hippoperdon pyriforme* Lév. in Annls Sci. nat. (Bot.) Sér. III, 5: 164. 1846 (basionym).

*Calvatia gardneri* (Berk. 1873) C.G. Lloyd 1904 (Sri Lanka).

*Calvatia gauzierioides* (Berk. & Br. 1873) Petch 1919 (Sri Lanka).

Tropical Africa, Mauritius, Sri Lanka, Java, Japan; forests. Type from Java, Indonesia.

*Calvatia subtomentosa* Dissing & M. Lange 1962

Tropical Africa; forests. Type from Zaire.

*Calvatia rugosa* (Berk. & Curt. 1869) Reid 1976

*Calvatia rubroflava* (Cragin 1885) Morgan 1890 (Kansas, U.S.A.).

*Bovista cisneroi* Speg. 1881 (Argentina).

*Bovista antarctica* Speg. 1887 (S. Chile).

Widespread in S. Europe (Italy) China, Japan, N., Cent., and S. America, Caribbean, Australia. Type from Cuba.

b) Capillitium with small pits

*Calvatia candida* (Rostk. 1839) Hollós 1902

*Bovista olivacea* Cooke & Massee 1887, doubtful synonym (Australia).

North America, Greenland, Iceland, S.E. Europe, temperate Asia, S. Africa, Australia, ? Panama. Type from Cent. Europe.

*Calvatia argentea* (Berk. 1836) Kreisel, *comb. nov.*

*Bovista argentea* Berk. in Ann. nat. Hist., Lond. 3: 400, 1836 (basionym).

Only known from the type (Madras, India; holotype K !).<sup>1</sup>

*Calvatia flava* (Massee 1887) Kreisel, *comb. nov.*

*Lycoperdon flavum* Massee in J.R. microsc. Soc. 1887: 721 (basionym) (Cape, S. Africa; holotype K !).

*Lanopila capensis* C.G. Lloyd 1923 (S. Africa).

South Africa; one doubtful collection from Sri Lanka.

c) Capillitium not pitted or with very minute pits

*Calvatia longicauda* (P. Henn. 1887) C.G. Lloyd

*Calvatia agaricoides* Dissing & M. Lange 1962 (Zaire).

Tropical Africa, Madagascar; forests. Type from Cameroon.

*Calvatia rosacea* Kreisel 1987

Tropical S. America. Only known by the type collection from Macas, Ecuador.

*Calvatia ochrogleba* Zeller 1947

Only known by the type collection from Oregon, U.S.A.

2. ***Calvatia* sect. *Gastropila* (Homrich & Wright) Kreisel, *comb. nov.***

*Gastropila* Homrich & Wright in Mycologia 65: 780. 1973 (basionym). Type species: *Mycenastrum fragile* Lév. 1844.

*Calvatia* stirps *Pachyderma* Zeller & Smith 1964.

Endoperidium thick, spongy; exoperidium thin, smooth. Capillitium with small pits. Subgleba none. Mature gleba olivaceous to brown.

<sup>1</sup> Specimens marked with '!' have been studied by the author.

***Calvatia pilula* Kreisel, *nom. nov.***

*Mycenastrum fragile* Lév. in Annls Sci. nat. (Bot.), Sér. III, 2: 221. 1844 (basionym).  
*Gastropila fragilis* (Lév.) Homrich & Wright 1973. Non *Calvatia fragilis* (Vitt. 1842) Morgan 1890 (see below).

*Calvatia primitiva* C.G. Lloyd 1904 (nomen nudum; doubtful synonym), fide Ponce de León 1976.

*Calvatia pachyderma* auct. p.p., pseudonym (e.g. Demoulin & al., 1988).

Western N. America (incl. Mexico), S. America, Medit. Europe (Spain, S. France), Australia, ? S. Africa. Type from Montevideo, Uruguay.

***Calvatia pachyderma* (Peck 1882) Morgan 1890**

Western N. America (Arizona, California, Oregon, Utah), high altitudes of Iran and Nepal. Type from Arizona, U.S.A. For restudy of the type, cf. Calonge & Martín, 1990.

**3. *Calvatia* sect. *Lanopila* (Fr.) Kreisel, *comb. nov.***

*Lanopila* Fr., Fungi Natalenses: 151. 1848 (basionym). Type species: *Lanopila wahlbergii* Fr. 1848.

Exoperidium smooth, thin. Capillitium not pitted. Subgleba none. Mature gleba olivaceous brown.

***Calvatia bicolor* (Lév. 1846) Kreisel, *comb. nov.***

*Bovista bicolor* Lév. in Ann. Sci. nat. (Bot.), Sér. III, 5: 162. 1846 (basionym). *Lanopila bicolor* (Lév.) Pat. 1899. *Langermannia bicolor* (Lév.) Demoulin & Dring 1975.

*Lanopila wahlbergii* Fr. 1848 (Natal, S. Africa).

*Lasiosphaera fenzlii* Reichardt in Fenzl 1870 (Nicobar Islands, Indonesia).

*Bovista glauccinerea* Speg. 1881 (Tuyú, Argentina).

*Bovista tosta* Berk. & Curt. 1888 (Cuba).

*Lanopila radloffiana* Verwoerd 1925 (Winberg, O.F.S., S. Africa).

Widespread in the tropics and subtropics of Africa, Asia, Indonesia, Caribbean, Cent. and S. America. Type from Bombay, India (PC and K!).

***Calvatia lacerata* A.H. Smith 1964**

Taxon of doubtful position, only known by the type collection from Oregon, U.S.A.

**4. *Calvatia* sect. *Langermannia* (Rostk.) Kreisel, *comb. nov.***

*Langermannia* Rostkovius in Deutschl. Fl., Pilze (ed. J. Sturm) III, 18: 23. 1839 (basionym). Type species: *Lycoperdon giganteum* Batsch 1786 : Pers. 1801.

*Calvatia stirps Gigantea* Zeller & Smith 1964.

Exoperidium smooth or deeply areolate. Capillitium with small pits. Subgleba indistinct, rudimentary. Mature gleba olivaceous brown. Size of fruit-bodies enormous, 80–600 mm diam.

*Calvatia gigantea* (Batsch 1786 : Pers. 1801) C.G. Lloyd 1904

*Calvatia bovista* (L. 1753) MacBride 1896 (Sweden), non *C. bovista* (Pers. 1795 : Pers. 1801) Kambly & Lee 1936 (= *Handkea utriformis* (Bull. : Pers.) Kreisel).

*Calvatia maxima* (Schaeff. 1774) Morgan 1890 (Bavaria, Germany).

Eastern N. America, Europe, temperate Asia, S. Africa, Australia, New Zealand. Type from Thuringia, Germany.

*Calvatia nipponica* Kawamura 1937 (nom. inval.; ICBN, Art. 36.1)

*Calvatia gigantea* (Batsch : Pers.) C.G. Lloyd sensu auct. japon. (pseudonym).

*Lasiosphaera fenzlii* Reichardt sensu Liu 1984 (pseudonym).

Japan, China. Type from Japan.

*Calvatia booniana* A.H. Smith 1964

Central U.S.A. (Idaho, New Mexico, Oregon, Utah, Colorado). Type from Oregon, U.S.A.

*Calvatia polygonia* C.G. Lloyd 1916 ex A.H. Smith 1964

Western U.S.A. (Colorado).

### 5. *Calvatia* sect. *Hypoblemma* (C.G. Lloyd) Kreisel, comb. nov.

*Hypoblemma* C.G. Lloyd, Mycol. Writings 1: 140. 1903 (basionym). Type species: *Lyco-perdon lepidophorum* Ell. & Ev. 1888.

Exoperidium smooth to areolate, thick, corky. Capillitium not pitted. Subgleba none. Mature gleba olivaceous brown.

*Calvatia lepidophora* (Ell. & Ev. 1888) Coker & Couch 1928

*Hypoblemma pachyderma* C.G. Lloyd 1902.

*Calvatia pachyderma* (Peck) Morgan sensu Morgan 1890 (pseudonym).

Central U.S.A. Records from Cent. Asia, Transcaucasia, and S. Africa require further study. Type from S. Dakota, U.S.A.

### 6. *Calvatia* sect. *Hippoperdon* (Mont.) Kreisel, comb. nov.

*Hippoperdon* Mont. in Annls Sci. nat. (Bot.), Sér. II, 17: 121. 1842 (basionym). Type species: *Hippoperdon crucibulum* Mont. 1842.

*Calvatia* stirps *Cyathiformis* Zeller & Smith 1964.

Exoperidium furfuraceous. Capillitium with small pits. Subgleba cellular, or compact, or none. Mature gleba violaceous.

*Calvatia crucibulum* (Mont. 1842) Kreisel, comb. nov.

*Hippoperdon crucibulum* Mont. in Annls Sci. nat. (Bot.) Sér. II, 17: 121. 1842 (basionym).

Caribbean, S. America. Type from Cuba (PC!).

Different from *Calvatia cyathiformis* by the huge subgleba with extremely large cells (lumen 1–6 mm diam.) and by the lanose, not pulverulent mature gleba.

*Calvatia cyathiformis* (Bosc 1811) Morgan 1890

*Lycoperdon fucatum* Lév. 1844 (Uruguay).

*Hippoperdon pila* Lév. 1844 (Uruguay).

North, Cent. and S. America, tropical Africa, tropical Asia, Japan. Type from Carolina, U.S.A.

*Calvatia fragilis* (Vitt. 1842) Morgan 1890

*Calvatia lilacina* (Mont. & Berk. 1845) P. Henn. 1904 (Australia).

*Lycoperdon novae-zelandiae* Lév. 1846 (New Zealand).

*Bovista cinerea* Ellis in Cragin 1885 (Kansas, U.S.A.).

*Lycoperdon violascens* Cooke & Massee 1887 (Australia).

*Bovista amethystina* Cooke & Massee 1888 (N. Africa).

*Bovista dealbata* Berk. ex Massee 1888 (New Zealand).

North America, N. Africa, S. Europe, Cent. Asia, S. Africa, Australia, New Zealand. Type from Italy.

The following species of this section are insufficiently known.—

*Calvatia sigillata* (Cragin 1885) Morgan 1890

Only known by the type collection from Kansas, U.S.A.

*Calvatia leiospora* Morgan 1895

Only known by the type collection from South Dakota, U.S.A.

*Calvatia rubrotincta* Zeller 1947

Only known by the type collection from Oregon, U.S.A.

#### 7. *Calvatia* sect. *Cretacea* Kreisel, *sect. nov.*

Exoperidium spinosum vel areolatum. Capillitium poris minutis vel magnis perforatum. Subgleba loculata vel rudimentaria. Gleba matura brunnea vel brunneoviolacea.

Exoperidium spiny or areolate. Capillitium with small or large pits. Subgleba cellular or rudimentary. Mature gleba brown or violaceous brown.

Type species: *Lycoperdon cretaceum* Berk. 1878.

*Calvatia cretacea* (Berk. 1878) C.G. Lloyd 1917

*Calvatia borealis* Th. Fr. 1914 (Torne Lappmark, Sweden).

Arctic N. America, Greenland, Iceland, Arctic Europe, Austria. Type from Belliott Island, N.W. Territories, Canada.

*Calvatia arctica* Ferd. & Winge 1910

Arctic N. America, Greenland, Iceland, Svalbard, Norway.

Type from E. Greenland.

*Calvatia septentrionalis* M. Lange 1990

Greenland, Iceland, Svalbard. Type from W. Greenland.

*Calvatia connivens* M. Lange 1990

Greenland, Iceland. Type from W. Greenland.

*Calvatia turneri* (Ell. & Ev. 1885) Demoulin & M. Lange 1990

*Calvatia tatraensis* Hollós 1901 (Czechoslovakia).

Eastern Canada, Greenland, Iceland, Svalbard, N. Europe, Alps, Caucasus, China, ? Mongolia. Type from Labrador, Canada.

*Calvatia bellii* (Peck 1885) M. Lange 1990

Eastern Canada, Greenland, Iceland, Svalbard. Type from Baffin Land (Labrador, Canada).

*Calvatia horrida* M. Lange 1990

Greenland, Svalbard. Type from Svalbard.

*Calvatia owyheensis* A.H. Smith in Zeller & Smith 1964

Only known by the type collection from Idaho, U.S.A.

*Calvatia pachydermica* (Speg. 1882) Kreisel, *comb. nov.*

*Bovista pachydermica* Speg., Fungi Patagonici: 25, No. 72. 1887 (basionym).

Fireland and southernmost Chile, several collections seen. Type from Punta Arenas, Chile (LPS !).

Miller & al. (1980) have synonymized most of the arctic taxa of this section with *C. cretacea*, whereas Lange (1990) recognizes seven species in the arctic region. Whether or not some of these taxa rather deserve infraspecific rank cannot be decided actually.

#### 8. *Calvatia* sect. *Sculpta* Kreisel, *sect. nov.*

Exoperidium spinas valde fortes, pyramidales, compositas, 5 ad 30 mm altas formans. Capillitium perforatum. Subgleba loculata. Gleba matura olivaceobrunnea.

Exoperidium of coarse, pyramidal, connivent spines 5–30 mm high. Capillitium pitted. Subgleba cellular. Mature gleba olivaceous brown.

Types species: *Lycoperdon sculptum* Harkness 1885.

*Calvatia sculpta* (Harkness 1885) C.G. Lloyd 1904

Western U.S.A. (California, Idaho, Oregon, Washington); in conifer forests at high altitudes. Type from California, U.S.A. This species is remarkable by its striking external resemblance with *Calbovista subsculpta* Morse, which occurs in the same area and habitat.

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